

# Rabies Control on Guam

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GUAM experienced its first recorded rabies epizootic in 1967. In an 8-month period, 89 cases of animal rabies were reported, of which 12 were confirmed; no cases of rabies in human beings were recognized. This paper describes some unusual problems associated with this outbreak, the control technique employed, and the results achieved.

When the first case of rabies was discovered in a dog in March 1967, the health department began a program to control the disease as encountered under urban conditions, concentrating on vaccinating pet dogs and capturing stray dogs. As more cases were reported, however, it became apparent that these efforts were not enough to stop the spread of rabies. The objective of removing the susceptible populations was correct, but the island's dense vegetation made it difficult to capture stray dogs. Therefore, a program of poisoning strays in both urban and rural areas was used to help quell the epizootic.

## Background

The island of Guam is 32 miles long, north to south, and 4 to 10 miles wide, with an area of 225 square miles. It is the southernmost and largest of the Mariana Islands in the western Pacific. The soil has a coral base in the northern

half and a lava base in the southern. The elevation rises to approximately 450 feet in the northern plateau and to a maximum of 1,328 feet in the southern mountain chain. The temperature ranges from 72° F. at night to 88° F. in the day throughout the year.

The tropical flora consists of tangantangan, coconut palm, and breadfruit. The tangantangan forms a dense undergrowth throughout most of the island. The fauna consists of deer, wild pigs, shrews, several species of rodents, reptiles, amphibians, fruit bats, and approximately 60 species of birds. The domestic animals are cattle, pigs, goats, carabao, horses, dogs, cats, and chickens.

The total population was estimated at 95,000 (50,000 civilian permanent residents, 30,000 military personnel, and 15,000 transient civilians). The island was established as an unincorporated territory of the United States by the Organic Act of Guam in 1950. The Government of Guam, the U.S. Navy, and the U.S. Air Force share responsibility for Guam's management. Approximately 40 percent of the total land area is under military jurisdiction.

The territory's economy is based on spending by the military services and civilian corporations fulfilling government contracts and local government revenues. Tourism, however, is rapidly developing, but there is no industry.

When the first case of rabies was diagnosed, the island was in danger of an outbreak because of the large number of stray dogs and cats. Estimated numbers of strays, including both dogs and cats, ranged from 20,000 to 60,000. Apparently they had multiplied at an uncontrolled rate for many years, and there also had been an

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influx of pets brought in by the military personnel in the recent military buildup. The large number of stray animals thrived on the abundant food available in open garbage containers throughout the civilian areas of the island.

### The Epizootic

Eighty-nine cases of animal rabies were reported in the 8-month period, but this report includes only the 12 cases confirmed by tests in more than one laboratory. The species and number of animals in each species with a diagnosis confirmed by the laboratories of the Center for Disease Control (CDC) were as follows:

Species	Number
Dog -----	4
Cat -----	4
Deer -----	3
Shrew -----	1
<b>Total -----</b>	<b>12</b>

Other suspected cases were excluded because of the possibility of laboratory error; the number of cases and the species were as follows:

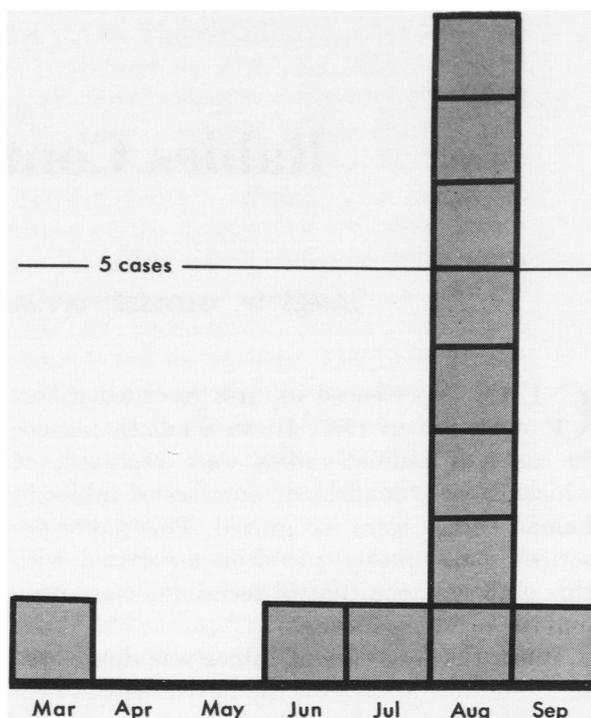
Species	Number
Dog -----	17
Cat -----	45
Deer -----	4
Shrew -----	8
Rat -----	2
Pig -----	1
<b>Total -----</b>	<b>77</b>

The initial confirmed case of March 6 was the index case. It occurred in a stray dog in the central part of the island adjacent to Apra Harbor, the commercial and naval port of Guam.

By June, the epizootic had spread through the northern half of the island but was limited to dogs; in July, the epizootic spread to cats and deer and peaked in August as shown on the chart. Rabies was not reported in the rural sparsely populated southern part of the island, because the disease simply may not have been recognized.

Because of the epizootic, 995 persons were reported to have been exposed to animals. These exposures were principally bites and scratches, but they also included any contact with the animal's saliva, such as licks on abraded skin, or other contacts. All persons were treated with

### Twelve confirmed cases of animal rabies on Guam, by month, 1967



tetanus antitoxin and the possibility of exposure to rabies was evaluated. Antirabies treatment (vaccine or serum, or both) was given to 131 persons. There were no cases of rabies in human beings.

The Government of Guam, the Navy, and the Air Force made plans to control the disease shortly after its discovery on the island. In May, the Governor asked the Public Health Service's Center for Disease Control to help evaluate the problem. Two CDC experts in rabies control were sent to the island and recommended that:

1. An embargo be placed upon the importation of dogs and cats into Guam.
2. All imported dogs and cats be quarantined for 120 days following cancellation of the embargo.
3. A public health veterinarian be provided by Guam to coordinate a rabies control program.
4. Stray dog control methods be improved, and the population of strays be reduced by biologists trained in techniques of suppressing animal populations. The U.S. Fish and Wildlife

Service was asked to assist the Guam Fish and Wildlife Service in this phase.

5. Adequate numbers of samples of brain tissue should be submitted to the laboratory for rabies examination to determine if control measures were satisfactory. To accomplish this testing, the Government of Guam was to provide a laboratory, and a technician was to be trained in rabies diagnosis. CDC would train the laboratory staff and supply reagents and backup services until the laboratory's diagnostic capability could be established.

6. Antirabies serum, as well as vaccine, was to be provided by the Territory of Guam Department of Public Health and Social Services for any civilian whose exposure to rabies was classified as "severe" (1).

A public health veterinarian from CDC and a wildlife biologist from the U.S. Bureau of Sports Fisheries and Wildlife (BSFW) were temporarily assigned to Guam. They urged the Governor to appoint a broadly based rabies advisory committee.

The committee members appointed by the Governor consisted of the chief Navy medical officer, chief Air Force medical officer, medical director of Guam's department of public health, Navy preventive medicine officer, Air Force veterinarian, Guam's director of agriculture, public health educator for Guam, BSFW wildlife biologist, and a Public Health Service veterinarian.

A state of emergency was declared by the Governor in June. This proclamation made the director of Guam's health department the coordinator for all activities of the various civilian departments participating in rabies control. A new dog control law was enacted to strengthen stray animal control by requiring all pet dogs to be leashed or confined to the owner's property. An emergency appropriation for rabies control provided for personnel and equipment. A new animal pound was constructed to quarantine suspect and aggressive biting animals.

#### **Health Education**

The full import of the epizootic was not immediately understood by the permanent residents because of their lack of experience with rabies. Misconceptions ranged from belief in

spontaneous generation of the disease to blind denial of confirmed laboratory evidence.

An intensive campaign to inform and educate the public was started soon after the laboratory confirmed the first case. The campaign during the first 3 months was aimed at getting favorable public response rather than at promoting a thorough understanding of rabies control. Repeated news releases dealt with the seriousness of the disease and the need for immediate reporting of all bites or other exposures, treatment, stray animal control, and the need for pet vaccination. Rabies fact sheets were distributed to teachers. The Lederle film "Rabies Can be Controlled" was shown in classrooms and repeatedly on television. Information was spread by radio, television, and newspapers in both English and Chamorro (the language of Guam).

After the first 3 months of the epizootic, the educational program was modified to develop a better understanding by the public of the long-range implications of rabies on the island and the value of intensive continuing followup to control the epizootic completely. Emphasis shifted to meetings where questions by the residents could be answered and meetings with the Governor's staff, various departmental staffs, village commissioners, civic club members, and for special target groups, such as school principals, science teachers, farmers' cooperatives, and the legislature's education, health, and welfare committee.

In September 1967, a short talk was given to all teachers, approximately 50 percent of whom were new to Guam, at the island-wide teacher's orientation meeting. Copies of a film, "Rabies Control in the Community" produced by the Public Health Service, were made available for showing at schools and on television for the next 9 months.

Close attention was paid to all complaints, and complaints that were constructive were incorporated into the program. Some of the suggestions adopted were the diverting of the scheduled patrols of the animal control officers to answer a resident's complaints of packs of loose dogs, apprehension of a biting animal, or the pickup of an unwanted pet. Top priority was given in answering such calls to minimize the time delay. Also a provision was made to

enable an owner to redeem his apprehended pet when it was determined that the animal was inadvertently released from his property by children or without his knowledge. The few emotional outbursts were answered with statements of fact, stressing the protection this program was giving the residents and their pets.

### Stray Animal Control Procedures

Initially the animal control officers captured animals easily; however, the strays soon became wary, and an increasing number of the strays avoided capture by hiding in the thick undergrowth.

Residents turned in many unwanted pets in March and April, but few animals were turned in for destruction and disposal in subsequent months. In October 1967, animal control officers conducted a house-to-house canvass in selected villages for animals whose owners did not want the responsibility, liability, or expense of pet ownership. They picked up 10 to 15 animals a day during this canvass.

In June two police officers, noted for their marksmanship, patrolled villages on clear nights and shot loose dogs, usually about five to 15 dogs per night.

The Governor requested the BSWF biologists to evaluate the stray dog and cat situation and to suggest control measures. They recommended toxic chemical suppression, provided a technique could be developed that offered maximum safety to the public.

After careful deliberation, officials under the technical leadership of a BSWF biologist selected a poisoning program using sodium monofluoroacetate, compound 1080 (2). This chemical was chosen because the lethal oral dose for dogs is 50 percent less than that required for other domestic animals. The lethal oral dose of the chemical for various species, according to Garner (3) are (all values expressed in milligrams per pound) dog, 0.03–0.09; pig, 0.14–0.18; cat, 0.14–0.22; goat, 0.14–0.32; horse, 0.22–0.75; and fowl, 4.5–13. Estimates of the lethal dose for man vary considerably. Gleason (2) reports the value to be 2.3 mg. per lb. while Dreisbach (4) reports the dose to be 50 to 100 mg. of sodium monofluoroacetate 1080. In a 150-pound man this is 0.33 to 0.67 mg. per lb. The Public Health Serv-

ice (5) has estimated that a dangerous dose for man is 0.22 to 0.9 mg. per lb.

Before this time, sodium monofluoroacetate 1080 had not been used officially for the destruction of dogs and cats any place in the United States. It was anticipated, and subsequently borne out, that the major difficulty with the use of this poison would be the destruction of pets whose owners ignored the warnings to abide by the leash law.

Large meat baits treated with sodium monofluoroacetate 1080 and tied to posts in village garbage dumps were first used. This method was not effective because dogs were not lured out of the villages; moreover, the large baits spoiled rapidly in Guam's climate.

Another method tried was the humane coyote "getter" placed along village streets at night during the period September 12–19. The getter was described by Buell (6):

A "getter" consists of a hollow stake driven into the ground until flush, or nearly flush, with the ground surface. In this stake is hooked a firing unit which contains a coil spring, a firing pin, and a setting mechanism. Above the ground is a small cylinder of cotton or wool about the size of an ordinary spool of thread. This "head" is covered with paraffin and smeared with a bait attractive to animals. Inside the cotton or wool head is a standard .38 caliber cartridge (minus the bullet and powder) which, in a holder, is screwed onto the firing unit. In lieu of the bullet and powder, the cartridge contains a light powder propelling charge, a small amount of sodium cyanide and activating material, some separating wads and on top a sealing compound. Only by pulling up on the cotton cylinder does the firing mechanism trip, setting off the cartridge and expelling the cyanide out the end of the cylinder into the mouth of the animal.

These units were effective with dogs but not with cats. The getter also took too much time to set and retrieve for this method to be considered efficient. A nightly average of only 32.8 percent of the devices were set off by animals (table 1). More important, the getter was not considered as safe as individual meat baits even though both methods were used only at night.

A study was conducted to determine the most efficient way to use sodium monofluoroacetate 1080 in individual small baits. The objectives were to establish lethal doses for dogs and cats, to learn how long dogs and cats lived after consuming baits, and to determine the acceptability

**Table 1. Number and percent of baits taken from coyote getter**

Day	Getters set	Getters fired	Percent
1-----	15	1	6.7
2-----	30	6	20.0
3-----	30	6	20.0
4-----	40	13	32.5
5-----	21	12	57.0
6-----	30	12	40.0
7-----	60	24	40.0
8-----	37	12	21.6
9-----	42	14	31.0
Total-----	305	100	32.8

and toxicity of baits containing food coloring and gentian violet. The study showed that individual meat baits injected with the poison were the most practical and effective. Spoiled beef was readily accepted despite the availability of garbage.

The meat was dyed with gentian violet to identify it as poisoned bait. Green vegetable food coloring was added to the toxicant which enabled easy detection of seepage from the meat. This step was felt to be necessary to insure that each bait contained the exact calculated dose. Therefore, any bait from which seepage was observed was destroyed. Each 1-ounce bait was injected with 3.4 milligrams of sodium monofluoroacetate 1080. This dose was calculated to kill all dogs weighing 73 pounds or less and all cats.

Knowledge of elapsed time from eating of the baits by animals until death occurred had a practical application in determining the time to place baits which would result in the fewest persons observing the dying animals. An average of 6 hours elapsed before death in dogs and 5¼ hours in cats given 3.4 milligrams of sodium monofluoroacetate 1080.

Before the poisoning program began, the public was told why poisoning was necessary and warned not to allow pets to run loose. Pamphlets were distributed door-to-door, handed out in the churches, given to the school children, and announcements were made on radio, television, and in newspapers.

Baits were distributed between 10 p.m. and 4 a.m., the optimal hours for animal foraging and the time least likely to endanger human lives by exposure to the baits, that is, people

were least likely to remove the baits or a child to ingest one accidentally. Baits were placed along public roads, near garbage cans, and at other sites in the villages where numerous stray animals were observed. They were placed on paper plates (one bait to a plate), which served as a visual aid in the collection of uneaten baits before sunrise. Later, trucks patrolled baited areas to pick up and dispose of carcasses.

Poisoning was conducted for 15 months. During this time 86.0 percent (14,053 of 16,329)

**Table 2. Number and percent of baits poisoned with sodium monofluoroacetate 1080 taken by animals, October 1967—December 1968**

Month	Total placed	Taken	Percent
October-----	2,446	2,243	91.7
November-----	2,382	2,096	88
December-----	2,359	2,085	88.4
January-----	1,629	1,455	89.3
February-----	417	364	87.3
March-----	1,619	1,393	86
April-----	386	248	64.3
May-----	1,845	1,523	82.5
June-----	620	534	86.1
July-----	976	888	91
August-----	513	343	66.9
September-----	690	552	80
October-----	218	196	90
November-----	116	72	62
December-----	113	61	54
Total-----	16,239	14,053	86.1

**Table 3. Dogs and cats destroyed on Guam, by month, 1967**

Month	Dogs	Cats	Total
January-----	359	49	408
February-----	326	38	364
March-----	3,407	270	3,677
April-----	1,878	302	2,180
May-----	931	75	1,006
June-----	911	349	1,260
July-----	934	482	1,416
August-----	842	891	1,733
September-----	875	304	1,179
October-----	1,596	308	1,904
November-----	760	173	933
December-----	587	152	739
Total-----	13,406	3,393	16,799

NOTE: Includes animals captured, turned in for disposal, shot, or poisoned.

SOURCE: Government of Guam. (Data from the U.S. Air Force and U.S. Navy are not available.)

of the baits were taken by animals. The most intensive phase of this activity was October through December 1967. In 60 nights, 6,424 baits were eaten (table 2). The number of baits placed depended on the number of loose dogs and cats observed on the established census route, which had been selected before the poisoning program started. In 1967, carcasses of 13,406 dogs and 3,393 cats were destroyed (table 3). In 1968, the number decreased to 1,795 dogs and 1,240 cats. The poisoning program ended on January 1, 1969. The number of animals picked up from the streets by then did not justify continuation.

Personnel from Andersen Air Force Base were trained by the wildlife biologist to set baits on the isolated restricted areas of the base. Their efforts resulted in 57.9 percent bait acceptance (1,643 of 2,806) for the period November 1967–February 1968.

#### **Vaccination**

In clinics held in each of the 19 villages 3,236 dogs and cats were inoculated with phenolized nervous tissue origin (NT) inactivated vaccine (7). Apparently, the Territory of Guam's public health officials decided that the use of this type of vaccine for dogs was an advantage since both dogs and cats were to be vaccinated at the same village clinic. The veterinary clinic of Andersen Air Force Base vaccinated 1,692 pet dogs and cats; 612 of the dogs were vaccinated with chick embryo origin (CEO) modified live virus vaccine (8), and the rest of the dogs and all cats were vaccinated with NT vaccine. In 1967, a total of 4,928 dogs and cats were vaccinated.

#### **Embargo and Quarantine**

The embargo was promulgated in August 1967 by an executive order of the Governor and was enforced for more than 12 months. During this time no dogs or cats, except sentry and Seeing Eye dogs were allowed to enter the island. It ended when the Territory of Guam and the State of Hawaii formed a quarantine agreement on August 16, 1968. After that time, Guam permitted entry of dogs and cats which had undergone 120 days of quarantine at the Hawaii Department of Agriculture Animal Quarantine Station. This arrangement con-

tinued until April 1, 1969, when Hawaii found it necessary to cancel the agreement. The embargo on dogs and cats was reestablished until construction of Guam's animal quarantine facilities was completed on July 2, 1969. Consultants from the Hawaii State Department of Agriculture helped plan the animal holding facilities on Guam. A 120-day quarantine seems adequate in minimizing the possibility of introducing rabies virus onto islands, judging from Hawaii's experience.

#### **Surveillance**

The Government of Guam and the U.S. Navy supplied the two laboratories on Guam. At CDC's Rabies Investigations Laboratory, Lawrenceville, Ga., civilian and military staff were trained in rabies diagnostic techniques which included Sellers staining (9), fluorescent rabies antibody (10), and mouse inoculation (11).

In 1967, 252 brains from several animal species were submitted to various laboratories for rabies examination; of these, 12 (5 percent) were positive for rabies virus and the results were confirmed by CDC's Virus Reference Laboratory. None of the 21 fruit bats examined by using fluorescent rabies antibody had any trace of virus. In 1968, the two island laboratories examined 224 brains, all of which were negative for rabies; 190 of these were sent to a CDC laboratory where all were verified as negative for rabies.

Reports of abnormal behavior in animals were investigated. Animals demonstrating such behavior were separated and observed, and brains from those that died were submitted to the laboratory. As surveillance continued, fewer reports were received. The number of bite treatment reports received and investigated declined from 995 in 1967 to 252 in 1969. This decline was undoubtedly due in part to the public's increased cautiousness about animal bites or exposure to suspect animals.

#### **Discussion**

The rabies control program was successful in stopping the epizootic because of the effectiveness of several factors:

1. The formation of the Governor's Rabies Advisory Committee assured the cooperation of the Navy and the Air Force with the civilian

program. The committee determined and endorsed policy and activities which resulted in a single island-wide rabies program. The committee's support of the use of a toxic agent to kill stray animals was particularly valuable.

2. The enactment of enabling legislation facilitated operations. A new dog control law not only strengthened stray animal control by the confinement of pets, but also waived the 5-day impoundment of strays, allowing for their immediate destruction, and it authorized enforcement officials to enter homes without a search warrant to apprehend unvaccinated animals.

3. The poisoning of stray dogs and cats proved to be the needed factor in breaking the chain of rabies transmission. From March through August, more than 15,000 susceptible animals were removed from the animal population by vaccination or destruction, representing a ratio of 1 animal to 8.6 people. With the addition of eight more confirmed cases in August, the need for a more drastic method of suppression was clearly demonstrated. The decision, although difficult, was made to poison stray dogs and cats. Unpleasant and undesirable at this decision was—poisoning was essential to stop the epizootic.

4. The insular setting restricted the area of operation. The embargo on pets helped stabilize the existing dog and cat populations. More important, it avoided the reintroduction of rabies via a dog or cat in whom the disease was incubating. The complete enforcement of the embargo was an example of the government's determination to stop the rabies outbreak.

The size of the stray dog and cat populations is reflected in the number of disposed carcasses. The reported data includes only animal carcasses collected by Government of Guam personnel. The total excludes animals which were destroyed and disposed of by military personnel, or privately (it was reported that many animals were destroyed by the permanent civilian residents), or those animals who died in the dense undergrowth. It is assumed that most dogs and cats which died in these areas would never be found.

The value of wildlife suppression programs for the control of rabies has long been discussed. Those arguing against such programs

contend that if left alone, an epizootic will eventually diminish by itself. The validity of this theory is not questioned, but the fact that rabies produces 100 percent mortality in man once symptoms appear requires that, as a matter of good public health practice, everything practical must be done to remove this threat to the public health as rapidly as possible.

To diminish itself, a rabies epizootic must kill a percentage of the susceptible animals at an uncontrolled rate and for an extended period. The program on Guam has demonstrated that a stepped-up and controlled elimination of susceptible animals by vaccination and destruction can stop a rabies epizootic in a relatively short period. Moreover, the epizootic was controlled without the eradication of any species.

Under most conditions, it would be illogical to compare dog and cat populations with wildlife species; however, on Guam they presented a situation similar to that of wildlife surrounding urban areas on the continent. In areas of the United States where wildlife suppression programs have been used and then prematurely suspended because of a reduction of reported cases, sporadic or numerous cases often appear later. On Guam there have been no cases of rabies after more than 36 months of constant surveillance and of sustained efforts to reduce the populations of stray animals.

This program has been of sufficient duration to permit a fair and adequate evaluation. It is concluded that the epizootic was stopped. If in the next 3 to 5 years no additional cases are reported, removal of the susceptible population should be credited not only with having stopped the epizootic but also with having eradicated the disease on Guam.

#### **Summary**

Guam's first known rabies epizootic, consisting of 89 reported cases, 12 of which were confirmed, was first detected in March 1967 and was effectively controlled within 8 months; there were no recognized cases of rabies in human beings.

The control program included vaccinating pet dogs and cats and drastically suppressing the unusually large stray animal populations. An embargo was placed upon pets entering the

island until dog and cat quarantine facilities could be built, an intensive campaign of education was put into effect, a system of reporting and investigating animal bites was established to insure medical attention for exposed persons, all animals who had bitten persons were quarantined and observed, rabies surveillance including laboratory diagnostic services was initiated, and rabies control activities were coordinated between the civilian and military jurisdictions on Guam.

In the last 9 months of 1967, of 995 persons who were exposed to animals, 131 received anti-rabies treatment, and 4,928 dogs and cats were vaccinated against rabies. In 1967, in the civilian communities, 16,799 dogs and cats were destroyed. The poison, sodium monofluoroacetate 1080, was used in both urban and rural areas. It had not been used officially for the destruction of dogs and cats any place in the United States. This technique is believed to have been instrumental in stopping the epizootic, since the last case of rabies was reported within 1 month after the poisoning program began. No cases of rabies have been reported since October 20, 1967.

The program was successful because of several factors: all jurisdictions cooperated, legislation was enacted to help meet the program's objectives, poison was used to suppress stray animals, and the setting was insular.

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#### Tearsheet Requests

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